



## ASSESSMENT OF THE DIAGNOSTIC ACCURACY OF COMPUTED TOMOGRAPHY (CT) SCAN TO DIAGNOSE INTESTINAL OBSTRUCTION: A CROSS-SECTIONAL RESEARCH

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### Abstract:

To evaluate CT scan's diagnostic accuracy as it pertains to the diagnosis of intestinal obstruction on the basis of histopathological analysis as gold standard.

**Methods:** A total of 111 subjects, who demonstrated clinical signs and symptoms of intestinal obstruction, participated in this study. Their ages ranged from twenty years to sixty years. CT scans were then carried out. During the CT scans, the parameters evaluated were: presence of any wall thickening of bowel or focal mass lesion at or around the level of obstruction, dilatation of bowel loops and presence of abrupt or gradual change of luminal calibre in the bowel. During the two procedures—CT scans and histopathological analysis— accuracy, sensitivity and specificity were also evaluated.

**Results:** The mean age of the 111 subjects that partook in the study was calculated to be  $(39.6 \pm 11.4)$  years, with the male to female ratio being approximately 1:1. With the aid of the CT scan procedure, intestinal obstruction was observed in seventy percent of the cases. By further employing histopathological analysis, seventy-three percent of the subjects were noted to demonstrate intestinal obstruction. In this study, the average accuracy was 69.4 %, the sensitivity was 95.1% and the specificity 96.7 %. From amongst all those who participated in the study, subjects that were older than 40 years were associated with a salient specificity value of 94.7 % and a sensitivity value of 100%. The subjects that were equal to or younger than 40 years in age exhibited a specificity value of 100% and a sensitivity value of 91.1 %. In the female subjects, the specificity values recorded were 100% and sensitivity values 90.2 %. In the male subjects, the specificity value recorded was 93.3 % and sensitivity value 100%.

**Conclusion:** CT scan is an exceedingly efficacious and sensitive test that is normally employed for the detection and assessment of bowel obstruction. It is useful in determining the etiological causes of the obstruction and the true locations of any suspected anatomical anomalies.

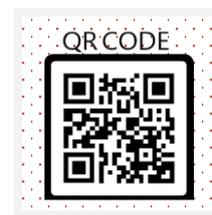
**Keywords:** Histopathology, CT scan, Diagnostic Accuracy and intestinal obstruction.

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**INTRODUCTION:**

Intestinal obstruction is widely regarded as a ubiquitous surgical emergency [1]. It is primarily classified into two types—dynamic obstruction and adynamic obstruction. In dynamic obstruction, peristalsis is understood to function in opposition to mechanical obstruction. In the case of dynamic obstruction, peristalsis takes the shape of a non-propulsive formation, meaning that the mechanical and physical forces that are imperative for the propulsion in the GIT, known as peristalsis, are working against an obstructive agent. In the case of adynamic obstruction, however, these peristaltic forces are entirely absent [2]. It is widely believed that instant surgery is required in acute obstruction since the patients present with a multitude of concerning symptoms. Surgical intervention is also merited in the case of partial obstruction, in which case there are traces of associated lesions [3]. Amongst the pathologies that necessitate urgent and prompt medical attention, mechanical intestinal obstruction presents as a pressing medical emergency in countries such as Pakistan, Iran and India [4].

Intestinal obstruction is rampant and abundantly prevalent in tropical countries such as Pakistan; however, a significant number of cases remains unreported, constituting a statistical and analytical challenge. Consequently, timely management in these dilatory cases is evaded, fomenting higher rates of associated complications [5].

A research by Zahid Mahmood et al [6] divulged that tuberculosis (TB) was singularly the commonest reason behind intestinal obstruction, with the percentage of cases that are caused by TB hovering above 38.13%. In 26.84% of the cases of TB-caused intestinal obstruction, obstructed/strangulated hernia developed as an overwhelming complication. Post-operative adhesions were found to be associated with 17.12% of the presented cases. Additionally, large gut malignancy was noted to be associated with 10.09% of the cases, posing significant concern. Volvulus and small gut malignancy were also found to be associated with 6.22% and 0.77% of the cases respectively.

The CT scan was calculated to be operating with a sensitivity value in the range (63 to 94 %), a specificity value in the range (78 to 100 %), and with an accuracy in the range (65 to 95 %) [7 – 11]. Abdominal X-ray, which is believed to be the traditional radiography procedure employed, manifested accuracy values ranging from 46% to 80 % [11 – 15]. It was further delineated that CT scan, in addition to providing a diagnostic means, can also accentuate the existence of closed-loop obstruction or strangulation, providing key information in the pathological context. Intestinal obstruction is now widely acknowledged to pose significant medical

risks, but these complications—and their association with intestinal obstruction—is only purported by a dearth of studies. The scarcity of studies conducted on the efficacy of CT scan has therefore necessitated the conduction of larger scale studies in order to ensure timely and effective management to thwart the aforesaid complications that commonly stem from these life-threatening pathologies.

**METHODS:**

Our cross-sectional study was carried out at the Shaikh Zayed Hospital, Lahore (Department of Radiology) during the period from December, 2016 to October, 2017. In favour of time and cost effectiveness, the sampling technique used in this study was chosen to be nonprobability (purposive). The sample size that was used for this study was 111 subjects. Informed consent from the subjects was duly obtained before proceeding with the study. One hundred and eleven subjects—which included both the genders (male and female)—were included in the study. Their ages ranged from twenty years to sixty years. The subjects chosen had all been afflicted with the complications of intestinal obstruction. Once the clinical examination was performed and brief history taken, abdominal CT scans were carried out. The most apt surgical intervention was recommended for the afflicted patients on the basis of aggregated radiological and clinical examination results. Histopathological results, in connection with operative specimens, were attained afterwards. The CT scans were performed using a multi-detector CT, MDCT, and with the inculcation of sixteen slices with the help of intravenous contrast material until medically contraindicated. The contrast material was administered orally two hours before and instantaneously prior to scanning. In some of the cases, prior to scanning, per rectal contrast material was also administered. In all of the cases, scans were carried out with eight or ten millimetre slice thickness, from the diaphragm dome till the symphysis pubis. From amongst, cases in which there were no conspicuous manifestations of intestinal obstruction, or in which the patients showed reluctance to further procedures, were excluded. Additionally, the subjects who were allergic to the contrast material itself were also excluded. During the CT scan test, the parameters evaluated were: presence of any wall thickening of bowel or focal mass lesion at or around the level of obstruction, dilatation of bowel loops and presence of abrupt or gradual change of luminal calibre in the bowel. The diagnosis of CT in relation to intestinal obstruction was based on the existence of disproportionate dilatation of bowel loops, particularly normal or collapsed bowel loops distally and dilated bowel loops proximally. Bowel loops were considered to be dilated or normal if they had a net diameter equal to or greater than 2.50 cm, and

collapsed if the bowel lumen was scarcely recognisable. Measurement of the optimal proximal bowel diameter was carried out from one external wall to the other external wall. The bowel wall was considered thick if its thickness was greater than 3 mm in a bowel distended loop. SPSS was then used as a statistical tool to compile and analyse the data such as the calculation of descriptive statistics and its related measures. The patient age, which is considered a quantitative variable, was deduced as mean  $\pm$  SD. Conversely, as far as the qualitative variables (intestinal obstruction diagnosis results by CT and by histopathological finding, gender and intestinal obstruction causes) are concerned, they were expressed in percentages and frequencies. 2 x 2 tables were utilised to calculate positive predictive value, specificity, sensitivity, and negative predictive values. The calculation of CT scan's diagnostic accuracy in identifying intestinal obstruction, by considering the histopathological results taken preoperatively as gold standard, was then carried out. To assess the effect(s) of the described parameters on results, stratification was carried out in pertinence to gender and age. As stated previously, the sample size for this study was 111 subjects, with a confidence interval of 95%, a margin of error of 10% and a specificity of 96%. The comparison of the sensitivity of the CT scan as a diagnostic tool for identifying intestinal obstruction with the gold-standard, preoperatively obtained histopathological results was performed in 94% of the total number of cases used.

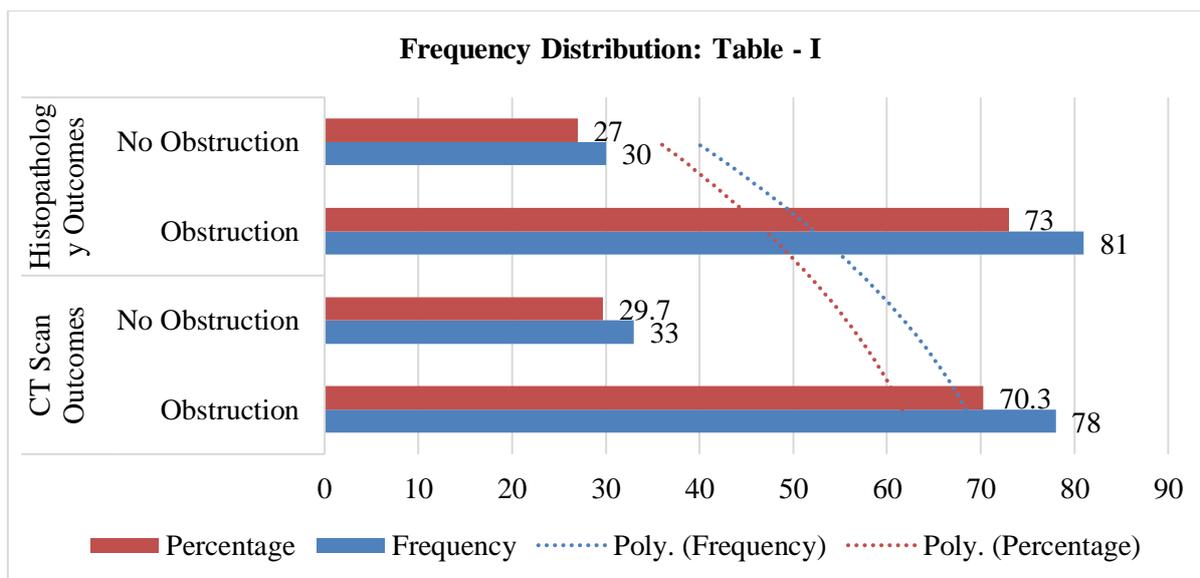
#### RESULTS:

In the total sample size of 111 subjects, the percentage of females was 50.5% (56 women), and the percentage of males was 49.5% (55 men). The male to female ratio in the study was (1: 1.01), with the mean age being ( $\leq 39.6 \pm 11.4$ ) years. The number of subjects aged forty years was 56, constituting 50.5 %, with the remaining fifty-five subjects aged  $>40$  years. Thirty-three subjects were diagnosed with no obstruction; however, seventy-

eight subjects were identified with intestinal obstruction in accordance with the CT scan results. As far as histopathological findings are concerned, eighty-one subjects were identified with obstruction whereas no obstruction was found in thirty cases as demonstrated in Table – I. The potential obstruction was observed to elicit postoperative adhesions in twenty-one (26%), carcinoma of colon and rectum in seven (8.7%), post appendicitis in three(3.7 %), Meckel's diverticulum in 01 (1.2 %), tuberculous stricture and adhesions in twenty-nine (35.8 %), strangulated hernia in fifteen (18.5 %), small bowel tumour or metastasis in three (3.7 %), and peritonitis (due to bladder rupture and haematoma) in two (2.4 %). It is imperative to mention here that out of the eighty-one cases, 01 subject with colonic carcinoma at splenic flexure and 02 cases with peritonitis were not found with bowel obstruction in accordance with the CT scan findings. The overall specificity of CT scan was noted to be 96.7 % and sensitivity 95.1 % (tabulated in Table – II). Intestinal obstruction was seen in seventy-seven cases in both procedures—that is, true positive and correctly diagnosed. Twenty-nine cases of no obstruction were noted in pertinence to both the procedures—that is, true negative, and correctly diagnosed. The average specificity of the CT scan was 96.7 %; the average sensitivity was 95.1 %, and the diagnostic accuracy was 69.4 % (also tabulated in Table – II). In post stratification analysis, the subjects who were aged  $\leq 40$  years were associated with a diagnostic accuracy of 73.2 %, a specificity of 100%, and a sensitivity of 91.1 %. In the subjects aged  $> 40$  years, however, the accuracy was noted to be 65.4 %, the specificity 94.7 % and the sensitivity 100%, as demonstrated in Table – III. Gender stratified analysis elucidated that the female subjects were associated with a 66.15 % diagnostic accuracy, 90.2 % sensitivity and 100 % specificity. On the other hand, the male subjects were concluded to be associated with a 72.7 % diagnostic accuracy, 93.3 % specificity and one hundred percent sensitivity as demonstrated in Table – III.

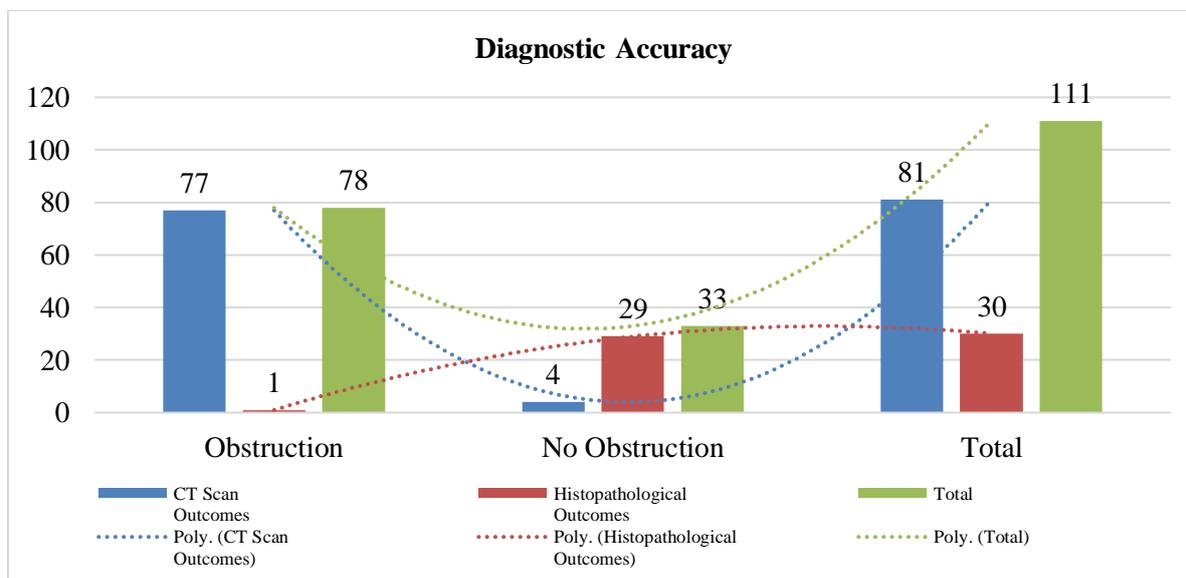
**Table – I:** Frequency distribution of intestinal obstruction among two procedures

| Intestinal Obstruction  |                | Frequency | Percentage |
|-------------------------|----------------|-----------|------------|
| CT Scan Outcomes        | Obstruction    | 78        | 70.3       |
|                         | No Obstruction | 33        | 29.7       |
| Histopathology Outcomes | Obstruction    | 81        | 73         |
|                         | No Obstruction | 30        | 27         |



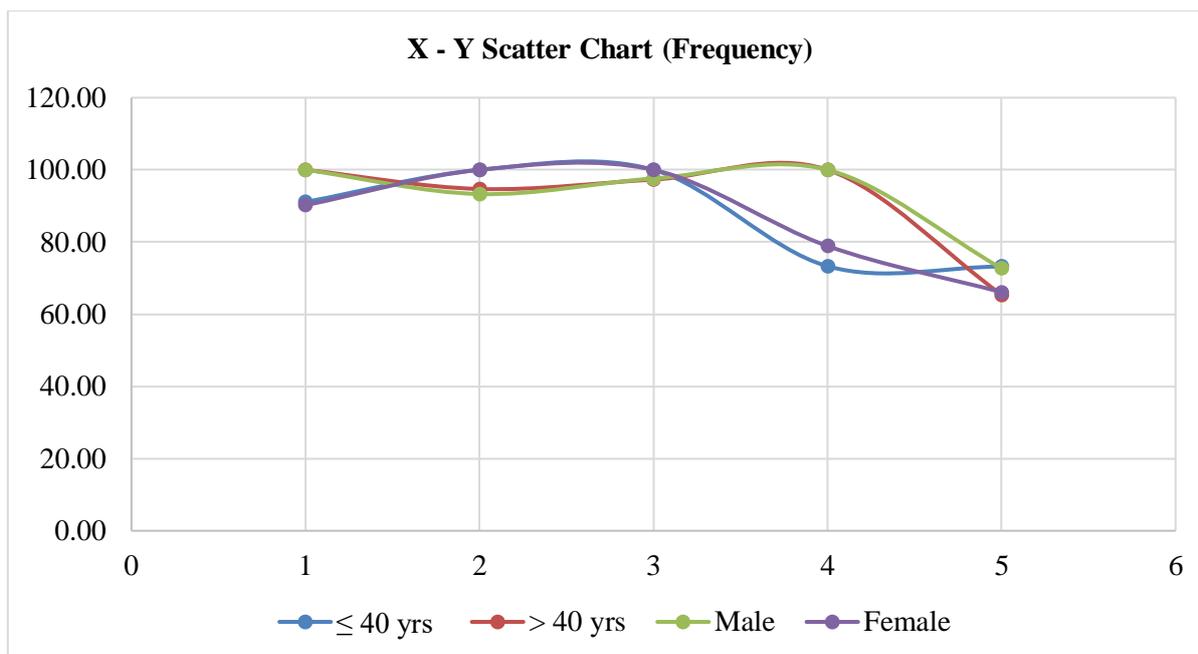
**Table – II:** Diagnostic accuracy of CT scan for the detection of intestinal obstruction

| Cases                 | CT Scan Outcomes | Histopathological Outcomes | Total |
|-----------------------|------------------|----------------------------|-------|
| <b>Obstruction</b>    | 77               | 1                          | 78    |
| <b>No Obstruction</b> | 4                | 29                         | 33    |
| <b>Total</b>          | 81               | 30                         | 111   |



**Table – III:** Diagnostic accuracy of CT Scan for detection of intestinal obstruction according to age and gender

| Diagnostic Accuracy              | ≤ 40 Years | > 40 Years | Male   | Female |
|----------------------------------|------------|------------|--------|--------|
| <b>Sensitivity</b>               | 91.10      | 100.00     | 100.00 | 90.20  |
| <b>Specificity</b>               | 100.00     | 94.70      | 93.30  | 100.00 |
| <b>Positive Predictive Value</b> | 100.00     | 97.30      | 97.60  | 100.00 |
| <b>Negative Predictive Value</b> | 73.30      | 100.00     | 100.00 | 78.90  |
| <b>Diagnostic Accuracy</b>       | 73.20      | 65.40      | 72.70  | 66.10  |



#### DISCUSSION:

Bowel obstruction is a rampant pathology that elicits a multitude of complications. The patients afflicted with this condition normally rely on conventional radiography for the confirmation of their diagnoses. As described above, the accuracy of this modality of diagnosis in identifying obstruction presence has been recorded to be within the 46 % to 80 % range. That said, however, it is imperative to highlight that the accuracy of this modality of diagnosis diminishes in cases of strangulation, and with varying etiological causes and locations of the concerning obstruction. The drastic amelioration in technological equipment, such as computed tomography, has fomented promising results in the detection of bowel obstruction. In instances where there are suspicious strangulations and inconclusive findings, CT scan is the preferred modality of diagnosis. This modality elucidates anatomical processes such as the mesenteric vessels, peritoneal cavity and bowel wall as well as the mesentery. Additionally, a research conducted by Ismail et al [16] on histopathological examination analysis has also indicated that tuberculosis is responsible for dynamic intestinal obstruction, in which case there is also a significant risk of developing consequent carcinoma of the large gut and postoperative adhesions. A research by Shaikh et al [4] has also reaffirmed this finding, concluding that the primary reasons for intestinal obstruction were: intestinal adhesion (23.33 %) and strangulated external hernias (25.83 %). In these cases, the aforesaid obstructions were followed by colonic malignancy (13.83 %), ileocecal tuberculosis (10.83 %) and large gut volvulus (13.83 %). Furthermore, Megibow et al. [10], in the aftermath of their research, have also suggested that from amongst the

76.2 % subjects validated to be suffering from intestinal obstruction, 23.8 % subjects were found to be pathologically healthy upon subsequent CT scan examination, further purporting the notion that CT scans can in fact be employed to great efficacy in clinical settings.

The right predictable cause of obstruction was recorded in forty-seven subjects out of the sixty-four patients (Seventy-three %). The main causes of obstruction in these cases were: colonic diverticulitis (3.1 %), Crohn's disease (6.3 %), adhesion (57.8 %), primary bowel tumour (10.9 %), metastases (3.1 %), hernia (4.7 %), haematoma (3.1 %), and other causes (4.7 %). The final, overall accuracy was 95 %, with the specificity and sensitivity being 96 % and 94 % respectively. The main causes of obstruction in our study were tuberculosis stricture/ adhesions, with their percentage hovering around 35.8 %. These cases of obstruction were then followed by postoperative adhesions (26%) and herniated obstruction/ strangulation (18.5 %). Various other reasons that were found to be responsible for the intestinal obstructions, in a large part, were small bowel tumour/metastasis (3.7 %), Meckel's diverticulum (1.2 %), colonic/rectal carcinoma (8.6 %), post appendicitis (3.7 %) and peritonitis (2.4 %).

It is pertinent to highlight, also, that the CT scan yielded a misdiagnosis in only 01 case of colonic carcinoma at splenic flexure and in cases of peritonitis (because of hematoma, urinary bladder rupture and so forth). In various other researches, the values of accuracy, specificity and sensitivity have also been noted to be 65 – 95 %, 78 – 100 % and 63 – 94 % respectively [7 – 11].

Our study, therefore, boasts an overall diagnostic accuracy of 69.4 %, a specificity of 96.7 % and a sensitivity of 95.1 %. The results obtained from various aforementioned studies, when used in conjunction with our present study, also point towards a significant accuracy percentage. It is for this high accuracy of the CT scan modality that recommendations for the uptake of CT scans are made as a first-line diagnostic procedure in patients presenting with intestinal obstruction.

#### CONCLUSION:

As elucidated above, our study has shown that CT scan is in fact a very efficacious diagnostic tool in relation to suspected intestinal obstruction. CT scan's high sensitivity, its high diagnostic accuracy, and the exceeding ease in the acquisition of the desired images render it a very viable first-line diagnostic modality in patients afflicted with intestinal obstruction.

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